ENGINEERING EVALUATION/COST ANALYSIS
OU2 OU3 (RICHARDSON FLAT TAILINGS SITE)

SITE ID: UT980952840

Draft
Site Characterization Report

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(Corrected)

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoPC	Contaminant of Potential Concern
CSM	conceptual site model
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ERA	Ecological Risk Assessment
FS	Feasibility Study
FSP	Field Sampling Plan
GPS	Global Positioning System
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HQ	hazard quotient
IDW	Investigation Derived Waste
O&M	Operations and Maintenance
OU1	Richardson Flat Tailings Site Operational Unit 1
OU2	Richardson Flat Tailings Site Operational Unit 2
OU3	Richardson Flat Tailings Site Operational Unit 3
OU4	Richardson Flat Tailings Site Operational Unit 4
PPE	personal protective equipment
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
RI	Focused Remedial Investigation
RMC	Resource Management Consultants, Inc.
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TAL	Target Analyte List
UDPR	State of Utah Division of Parks and Recreation
United Park	United Park City Mines Company
USFWS	U.S. Fish & Wildlife Service
USGS	United States Geological Survey
XRF	field portable X-Ray fluorescence meter

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1.0 INTRODUCTION

This Site Characterization Report (Report) summarizes and evaluates data collected during the field investigation that was performed for the Engineering Evaluation/Cost Analysis (EE/CA) at Operable Units (OU) 2 and 3 of the Richardson Flat Tailings Site in Park City, Utah United Park City Mines Company (United Park)is conducting this work pursuant to an Administrative Settlement Agreement and Order on Consent for an EE/CA Investigation and Removal Action, dated March 6, 2014, U. S. EPA Docket No. CERCLA-08-2014-0003 (the AOC). The work was performed in accordance with the EE/CA Work Plan and Sampling and Analysis Plan (SAP) that was prepared by Resource Environmental Management Consultants (RMC) for United Park. This report includes an outline for the EE/CA Report as Appendix A.

1.1 Site Description and Background Information

Operable Unit 2 and 3 boundaries are presented in Figure 1-1 and generally described below. Operable Unit boundaries are defined in the AOC.

OU2

OU2 is referred to generally as Lower Silver Creek and extends approximately 4.5 miles along Silver Creek from U. S. Highway 40 on the southern end to Interstate 80 on its northern end, ranging in width from approximately 2,100 feet at the southern boundary to approximately 3,800 feet near Pivotal Promontory Road. Areas within OU2 are separate from but contiguous with the areas of OU3. The AOC applies to both OU2 and OU3.

OU3

OU3 is comprised of five separate areas as presented on Figure 1-1:

- Middle Reach – The first area is commonly known as the Middle Reach of Silver Creek. This area encompasses the Silver Maple Claims from its upstream end at Prospector Park downstream to U.S. Highway 40;
- Floodplain Tailings Reach (FPT Reach) – The second area extends from U.S. Highway 40 northward to State Route 248. A portion of this area is referred to as the "Floodplain Tailings" in the OU1 RI/FS (RMC, 2004); This area was initially included as part of OU2;
- State Route 248 North Reach – The third area extends from State Route 248 northward approximately 9,000 feet through the southerly one-third of the Lower Silver Creek floodplain. This area was initially included as part of OU2;

- P. C. West – The fourth area is located in the northern part of OU3 and is adjacent to the Snyderville Basin Water Reclamation Facility (sewage treatment facility) to the west. This area was initially included as part of OU2; and
- P. C. East – The fifth area is located in the northern part of OU3 to the north of Promontory Road and is adjacent to a residential development, Pivotal Promontory, LLC, which has constructed a private club and second-home community on the eastern OU3 boundary. This area was initially included as part of OU2.

The Site ranges from approximately 6,475 to 6,800 feet above mean sea level. The Site is located in the Wasatch Mountains, approximately 20 miles northwest of Salt Lake City, Utah.

Silver Creek and the adjacent floodplain receive water from sources that include, but may not be limited to precipitation (primarily snowmelt), groundwater, springs, and urban runoff located within its basin. The 1986 Utah Department of Natural Resources (DNR) report "Water Resources of the Park City Area, Utah with Emphasis on Groundwater," prepared in cooperation with the United States Geological Survey (USGS), indicates that Silver Creek obtains its base flow from springs in consolidated rock. The DNR report also indicates that the primary groundwater contributor to Silver Creek base flow is Dorrity Spring, located north of Prospector Square (DNR, 1986). Silver Creek is the primary drainage within the watershed.

The Site is characterized by a cool, dry, semi-arid climate. Long-term meteorological observations have not been kept at the Site. The two nearest meteorological data stations are located in Park City, Utah (which is 500 feet higher in elevation and two miles to the southwest in the Wasatch Mountains), and Kamas, Utah (located at a similar elevation to the Site and nine miles to the east). Annual precipitation for the Site likely falls between the values recorded at the two meteorological stations. Annual precipitation at Park City is 21.44 inches of water with an average annual low temperature of 30.8 degrees and an average annual high temperature of 56.3 degrees. Annual precipitation at Kamas is 17.27 inches of water per year with an average annual low temperature of 29.0 degrees and an average annual high temperature of 58.7 degrees (www.wrc.dri.edu, 2001).

Long-term wind data have not been kept in the vicinity of the Site. The prevailing wind direction is from the northwest to southeast as determined by the EPA contractor Ecology and Environment (E &E) during an air monitoring assessment conducted at OU1 in 1986 (E&E, 1987).

The Site is located within a complex fold and thrust belt later intruded and overlain by volcanic rocks. The area located within the Silver Creek floodplain is composed of colluvium and alluvium derived from sedimentary and volcanic formations located within the Silver Creek watershed. Wetland and upland areas within the Site are generally underlain by the Keetley

Formation volcanic rocks which may be more than 1,000 feet thick (Weston, 1999, in RMC, 2004).

The Site is composed of wetland and upland habitats and plant communities. Currently there are no residential properties within the Site boundary. The area is used by recreational visitors and workers also may intermittently enter the Site.

Previous Investigations within the boundaries of OU2 and OU3 were conducted by:

- Tetra Tech (for EPA);
- United Park City Mine Company;
- USGS;
- BLM;
- Upper Silver Creek Watershed Stakeholders Group; and
- State of Utah.

Detailed summaries of previous investigations are presented in Section 1.1.4 of the Sampling and Analysis Plan (SAP) (RMC, 2014).

1.2 Goals, Objectives, and Overview

The goal of the site characterization is to define the nature and extent of contamination and to evaluate potential risks posed to human and ecological receptors by metals in surface water, shallow groundwater, soils, sediments, tailings and biota at OU2 and OU3. To meet this goal, a field investigation was conducted beginning in November 2014 and completed February 2016. Field activities are described in detail in the following sections.

The objectives of sampling activities were to:

- Determine the nature and extent of contamination;
- Collect data of sufficient quantity and quality to complete this Report. Data collected was used to fill in data gaps from previous studies;
- Collect data to perform ecological and human health risk assessments; and
- Collect data to determine potential removal alternatives.

All field work was conducted in accordance with the approved SAP, with the exception of additions and deviations described in Section 2.6. The field investigation consisted of the following activities for each OU.

- Surface Water: Surface water samples were collected quarterly for one year from OU1, OU2, and OU3. Figure 1-2 (Sheets 1 - 4) presents surface water sampling locations. OU1

surface water discharge was sampled quarterly to quantify metals loading from OU1 and demonstrate the effectiveness of source control efforts undertaken in OU1 from 2007 to 2011. Surface water samples were collected from twelve locations within OU2 and seventeen locations within OU3.

- Groundwater: Groundwater samples were collected quarterly for one year from OU2 and OU3. Figure 1-3 presents groundwater sampling locations. To determine seasonal fluctuations in groundwater levels, water level measurements were conducted monthly for one year. Samples and water level measurements were collected from 12 piezometers previously installed by Tetra Tech within OU2. Samples and water level measurements were collected from 17 piezometers in OU3.
- Soils and Tailings: Surface and subsurface soil and tailings samples were collected from OU2 and OU3 to define vertical and horizontal extents of contamination. Soil sampling locations are presented on Figure 1-4. One-hundred and ninety seven soil samples were collected from OU2. These are comprised of surface and subsurface soil samples; 132 samples are located in the OU2 floodplain and 65 samples are located in the OU2 upland area. Three hundred and seventy eight soil samples were collected from OU3. These are comprised of surface and subsurface soil and tailings samples; 226 samples were collected from the OU3 floodplain and 152 samples were collected from the OU3 upland area.
- Sediment and Organism Tissue: Sediment and organism tissue (vegetation, benthic macroinvertebrates and fish) samples were collected from sample locations co-located with Silver Creek surface water sampling locations. Benthic macro-invertebrates were collected from four locations in OU2 and eight locations in OU3. Sediment and vegetation samples were collected from five locations in OU2 and nine locations in OU3. Fish samples were collected from four locations in OU2 and four locations in OU3. Sample locations are presented in Figure 1-5.

Quarterly status reports were submitted to EPA summarizing field activities.

The data collected was evaluated from a hydraulic and contaminant point of view and included:

- Evaluation of soil, groundwater, surface water, and sediment and organism tissue contaminant concentrations to determine if elevated contamination exist that can be targeted for removal alternative evaluation;
- Performing a mass loading analysis to assess potential relative contaminant contributions to downstream areas, and overall contaminant fate and transport ;
- Perform Phase I screening ecological and human health receptors against acceptable criteria.

2.0 PRESENTATION OF FIELD ACTIVITIES AND RESULTS

Site characterization field activities commenced in November 2014 and continued through February 2016. All work was conducted in accordance with the approved EE/CA Work Plan and SAP. The following sections provide a summary of the work performed. Table 2-1 below presents a Summary of Site Characterization Field Activities.

Event	Timeframe	Dates
Piezometer Installation	March 2015	3/2/2015
Quarterly Sampling (Groundwater and Surface Water):		
First Quarter(Q1)	March 2015	3/9/13 to 3/13/15
Second Quarter (Q2)	May 2015	5/26/15 to 5/28/15
Third Quarter (Q3)	August to September 2015	8/31/15 to 9/1/15
Fourth Quarter (Q4)	November 2014 & October 2015	11/12/14 & 10/8/15 to 10/9/15
Monthly Groundwater Elevation Measurements:		
Month 1	March 2015	3/10/15 to 3/16/15
Month 2	April 2015	4/20/15
Month 3	May 2015	5/11/15 to 5/13/15
Month 4	June 2015	6/22/15
Month 5	July 2015	7/20/15
Month 6	August 2015	8/25/15 to 8/27/15
Month 7	September 2015	9/23/15
Month 8	October 2015	10/6/15 to 10/7/15
Month 9	November 2015	11/20/15
Month 10	December 2015	12/18/15
Month 11	January 2016	1/21/16 to 1/27/16
Month 12	February 2016	2/23/16 to 2/24/16
Soil Sampling	November 2014 to October 2015	11/10/14 to 10/5/15
Sediment and Organism Tissue Sampling:		
Sediment	November 2014 & July 2015	11/12/14 & 7/27/15 to 7/28/15
Vegetation	July 2015	7/27/15 to 7/28/15
Benthic Macroinvertebrates	August 2015 & September 2015	8/17/15 to 8/20/15; 9/3/15 to 9/9/15
Fish	August 2015 & September 2015	8/17/15 to 8/21/15; 9/3/15 to 9/9/15

2.1 Quarterly Surface Water Sampling, Field Water Quality and Flow Measurements

To evaluate water quality throughout OU2 and OU3, quarterly surface water samples were collected and analyzed in accordance with the SAP (RMC, 2014). Surface water samples were analyzed for total and dissolved metals and general chemistry parameters as presented in Table 2-3. Minimum and maximum cadmium and zinc concentrations are presented on Figure 2-1. Surface water samples were collected in order to:

- Evaluate source areas to the extent practicable;
- Evaluate surface water and groundwater interaction to the extent practicable;

- Determine exposure of human and ecological receptors, including benthic macroinvertebrates, fish, and wildlife to metals;
- Estimate metals dose and risk to wildlife ingesting water, and applicable subsequent human health considerations (i.e., game fish consumption);

To complete these evaluations, surface water samples were collected quarterly from November 2014 to October 2015. Field water quality parameters and flow measurements were collected during surface water sample collection. Field Water Quality Parameters are presented in Table 2-4. Flow measurements are presented in Table 2-5. Hydrographs were created to summarize flow measurements and are presented in Appendix D.

Section 3 of this characterization report presents results of surface water sampling with respect to site characterization.

All data was validated in Quality Assurance/Quality Control (QA/QC) Reports submitted to EPA. QA/QC Reports are included in Appendix C. All data were found to be usable. The overall assessment found data to be acceptable with the assigned qualifiers as discussed in QA/QC Reports.

2.2 Quarterly Groundwater Sampling, Field Water Quality and Static Water Level Measurements

Quarterly groundwater samples were collected and analyzed in accordance with the SAP. Groundwater samples were analyzed for total and dissolved metals and general chemistry parameters as presented in Table 2-6. Groundwater samples were collected in order to:

- Evaluate source areas to the extent practicable;
- Evaluate surface water and groundwater interaction to the extent practicable; and
- Determine seasonal groundwater flux to the extent practicable.

To complete these evaluations, groundwater samples were collected quarterly from March 2015 to October 2015. Field water quality parameters were measured during ground water sample collection. Static water levels were collected monthly from March 2015 to February 2016 to determine seasonal groundwater flux. Static water levels are presented in Table 2-7. Field Water Quality Parameters are presented in Table 2-8. Section 3 of this characterization report presents results of ground water sampling with respect to site characterization.

All data was validated in Quality Assurance/Quality Control (QA/QC) Reports submitted to EPA. QA/QC Reports are included in Appendix C. All data were found to be usable. The overall

assessment found data to be acceptable with the defined qualifiers as discussed in the QA/QC Reports.

2.3 Surface and Subsurface Soil, and Tailings Sampling

Surface and subsurface soil and tailings samples were collected and analyzed in accordance with the SAP. Soil and tailings samples were analyzed for total and dissolved metals, phosphorus, and percent moisture as presented in Table 2-9. Surface and subsurface soil and tailings samples were collected in order to:

- Determine nature and extent of contaminated surface and subsurface soils;
- Determine exposure of humans and ecological receptors to metals; and
- Prepare estimates of contaminated soil volumes.

To complete these evaluations, surface and subsurface soil samples were collected intermittently from November 2014 to October 2015. In accordance with the SAP, surface soil samples were collected between 0 – 2 inches. Subsurface samples were collected using a variety of tools depending on required sampling depths. A field portable X-Ray Fluorescence Meter (XRF) was used as a screening tool to determine when at-depth soil sampling had reached the lower extent of contamination. Figure 2-2 presents Arsenic, Lead, Cadmium, and Zinc analytical results for each surface soil sample collected. .

Tailings samples were collected from each soil sample location where visually evident tailings were present. Depths of tailings were noted during sample collection. XRF screening was conducted above and below any color and texture changes. Tailings sample results are presented in Table 2-9.

Section 3 of this characterization report presents results of surface and subsurface soil sampling, and tailings sampling with respect to site characterization.

All data was validated in Quality Assurance/Quality Control (QA/QC) Reports submitted to EPA. QA/QC Reports are included in Appendix C. All data were found to be usable. The overall assessment found data to be acceptable with the defined qualifiers as discussed in the QA/QC Reports.

2.5 Sediment and Organism Tissue

Sediment and organism tissue (vegetation, benthic macroinvertebrates, and fish) samples were collected and analyzed in accordance with the SAP. Sediment and organism tissue samples were analyzed for total metals, phosphorus, and percent moisture. Sediment, vegetation, benthic macroinvertebrate, and fish sample results are presented in Table 2-10, 2-11, 2-12, and 2-13, respectively. Sediment and organism tissue samples were collected in order to:

- Compare results to OU1 Baseline Ecological Risk Assessment values;
- Quantify dietary exposure pathway for humans consuming game fish;
- Quantify dietary exposure pathway for semi-aquatic birds and mammals;
- Examine trends relative to contaminant trends in abiotic media;
- Evaluate uptake of metals from sediment and surface water; and
- Determine bioaccumulation of metals.

To complete these evaluations, sediment and organism tissue samples were collected in November 2014, and July, August and September 2015. Section 3 of this characterization report presents results of sediment and organism tissue sampling with respect to site characterization.

All data was validated in Quality Assurance/Quality Control (QA/QC) Reports submitted to EPA. QA/QC Reports are included in Appendix C. All data were found to be usable. The overall assessment found data to be acceptable with the defined qualifiers as discussed in the QA/QC Reports.

2.6 Additions/Deviations from the Sampling and Analysis Plan (SAP)

Field work conducted during completion of this EE/CA was largely conducted in accordance with procedures identified in the SAP (RMC, 2014), although additions and deviations occurred. Additions and deviations are summarized below. Additional field work not presented in the SAP will allow for better understanding of the study area. Deviations from the SAP are not expected to impact data quality, as described below. Many deviations from the SAP were made in concurrence with sampling oversight by EPA or another regulating agency as described below.

Additions to SAP

As stated in the FSP, surface water sampling locations would be added in the field if flow is observed in irrigation ditches or from springs or seeps discharging shallow groundwater (RMC 2014). Four opportunity samples were collected during the March 2015 surface water sampling event, locations are presented on Figure 1-2:

- OU2-0-SW-PPTRIB;

- OU2-0-SW-SGDINF;
- OU2-0-SW-STRGD; and
- OU3-0-SW-SPRRP.

Five opportunity soil samples were collected in the summer of 2015 as presented on Figure 1-4:

- OU2-0-SO-OP1-0
- OU2-0-SO-OP1-0.501
- OU2-0-SO-OP1-022.5
- OU2-0-SO-OP2-0
- OU2-0-SO-OP2-0.501

Deviations to SAP

Deviations from the SAP occurred during field activities. Deviations that occurred during each sampling event are discussed below.

In November 2014, surface water, soil, sediment, and tailings sampling was conducted. One surface water sampling location was relocated approximately 100 feet downstream and four soil sampling locations were relocated approximately 100 feet northwest from the proposed sampling locations included in the SAP due to unsafe accessibility conditions.

The following sample locations were relocated:

- OU3-0-SW-SCBOU4
- OU3-0-SO-MRU-3A-0;
- OU3-0-SO-MRU-3A-0.501;
- OU3-0-SO-MRU-4A-0;
- OU3-0-SO-MRU-4A-0.501;
- OU3-0-SO-MRU-6A-0;
- OU3-0-SO-MRU-6A-0.501;
- OU3-0-SO-MRU-6B-0; and
- OU3-0-SO-MRU-6B-0.501.

These sample location changes did not alter the SAP in any way.

In March 2015, surface water, groundwater, tailings, and soil sampling was conducted. All specified field parameters were collected (pH, temperature, conductivity, DO, ORP, flow) except at the six groundwater sample locations. Conductivity was not recorded at the locations listed below:

- P2-5;
- P2-1(A);
- T6E0375;
- T6W0625;

- T6E1350; and
- T5E1875.

One groundwater sampling location was permanently relocated from the proposed sampling locations in the SAP. Piezometer FPT-6A was purged and in good working condition during the November 2014 reconnaissance; however, during the March 2015 sampling event the piezometer had extensive damage and was snapped from the base. An alternative piezometer located approximately 200 feet northeast was selected to permanently replace the previous location. The new location retained the sample ID of FPT-6A and was sampled thereafter. Based on heterogeneity of the alluvial deposits and estimated gradient, the replacement sample location is representative, and the change did not alter the intent of the SAP in any way.

During the groundwater sampling event, four piezometers had insufficient water quantity and samples were not collected:

- MR-2;
- MR-5;
- P2-1; and
- T4E1375.

In May 2015, surface water and groundwater sampling was conducted. All specified field parameters were collected (pH, temperature, conductivity, DO, ORP, flow) at locations with adequate water, except for locations sampled on May 11th and May 12th. On the morning of May 11th, a rental YSI 556 used to measure field parameters was calibrated according to the user's manual. After reaching the first sample location, the YSI 556 would not turn back on. Batteries were removed and replaced and re-calibration was performed over the phone with the rental company; however a calibration remained out of range and questionable. A replacement YSI 556 was received and started being used on May 13th. To supplement the questionable YSI readings, the laboratory field parameter data was retained and considered 'J' qualified. The questionable field parameters collected on May 11th and 12th were rejected, as 'R' qualified.

Surface water flows were not measured at six locations due to insufficient water:

- OU3-SW-SCOU3BC
- OU1-SW-PFOU1
- OU3-SW-SCURTFB
- OU3-SW-MRUBP
- OU3-SW-SCBOU4
- OU3-SW-SCAOU4

Based on review of first quarter laboratory data and concurrence with EPA oversight, no water was present therefore samples, flow data, or field water quality measurements were not collected from:

- OU3-SW-HS

- OU3-SW-NGCF

No laboratory or field parameter samples were collected from four piezometers due to insufficient water quantity:

- OU2-GW-T4E1375 Dry, no sample collection
- OU3-GW-P2-1(B) Dry, no sample collection
- OU2-GW-T3E1125 Dry, no sample collection
- OU3-GW-MR-4 Dry, no sample collection

At two piezometers, only total and dissolved metals were analyzed due to insufficient water observed during sampling:

- OU3-GW-MR-2
- OU3-GW-MR-1

This analytical modification is in accordance with the SAP.

In July through October 2015, surface water, groundwater, soil, tailings, sediment, benthic macroinvertebrate, fish and vegetation tissue, sampling was conducted. In concurrence with EPA oversight, 90.2% of planned samples were acquired during summer 2015 sampling. Two benthic macroinvertebrate locations, 6 fish locations, 22 groundwater locations, 53 soil locations, and 9 surface water locations were not sampled. Specific locations and reasons for not sampling are discussed below.

Methylmercury was removed from sediment, vegetation, fish, and macroinvertebrate laboratory analysis. When the samples were submitted for analyses the laboratory stated they do not perform methylmercury analysis. According to United Park the EPA RPM approved the deletion of methylmercury from the analytical suite.

During benthic macroinvertebrate sampling, two locations had insufficient water and samples were not collected:

- OU3-BM-SC248NRB
- OU2-BM-IRF

During fish sampling, two locations had insufficient water and samples were not collected:

- OU3-FI-SC248NRB
- OU2-FI-IRF

Four sampling locations produced an insufficient number of fish and/or weight to collect a laboratory sample:

- OU3-FI-MRUBP
- OU3-FI-SCURTFB
- OU3-FI-SC248AC
- OU3-FI-SC1C

Two sampling locations produced insufficient number of fish and/ or weight for the required three samples, and two laboratory samples were collected:

- OU3-FI-SCRF72
- OU2-FI-SCI

In August 2015, groundwater laboratory samples were not collected from five piezometers due to insufficient water quantity, field parameters were collected at:

- OU2-GW-T6E0375
- OU2-GW-T3E1125
- OU3-GW-FPT-2B
- OU3-GW-MR-2
- OU3-GW-MR-3

In August 2015, groundwater samples and field parameters were not collected from six piezometers due to insufficient water quantity:

- OU3-GW-P2-1(B)
- OU2-GW-T5E1875
- OU3-GW-T2W0375
- OU3-GW-RT-12
- OU3-GW-MR-4
- OU2-GW-T4E1375

In October 2015, groundwater laboratory samples were not collected from two piezometers due to insufficient water quantity:

- OU2-GW-T3E1125
- OU3-GW-RT-12

In October 2015, groundwater samples and field water quality measurements were not collected from nine piezometers due to insufficient water quantity:

- OU2-GW-T6E0375
- OU3-GW-P2-1(B)
- OU2-GW-T5E1875
- OU3-GW-FPT-2B
- OU3-GW-MR-4
- OU3-GW-MR-2
- OU3-GW-MR-1
- OU2-GW-T4E1375
- OU3-GW-T2W0375

When necessary, soil sampling locations were relocated due to accessibility issues, to avoid fill/ construction materials, or to avoid hazards, such as utility lines. Six soil sampling locations were relocated by approximately 20 to 50 feet:

- OU3-SO-ER-10Q
- OU3-SO-ER-1J
- OU3-SO-ER-1N
- OU3-SO-NR-16K
- OU3-SO-MRU-11C
- OU2-SO-21D

These sample location changes did not alter the intent of the SAP in any way.

Samples were not collected at 20 soil sampling locations due to accessibility issues, fill/construction materials, and/or hazards:

- OU3-SO-NR-11G
- OU3-SO-FT-6C
- OU2-SO-MRL-14D
- OU3-SO-MRL-14E
- OU3-SO-MRL-15A
- OU3-SO-MRL-15B
- OU3-SO-MRL-15C
- OU3-SO-MRL-16C
- OU3-SO-MRL-16E
- OU3-SO-MRU-8A
- OU3-SO-MRU-9D
- OU3-SO-MRU-10D
- OU3-SO-MRU-11D
- OU3-SO-MRU-12D
- OU2-SO-1A
- OU2-SO-16R
- OU2-SO-26F
- OU2-SO-28F
- OU2-SO-30F
- OU2-SO-40S

One subsurface soil sample was not collected due to presence of bedrock:

- OU3-SO-MRU-9B

One subsurface soil sample was not collected because of difficult sampling conditions; however, a surface soil sample and one foot depth soil sample were collected. The sample location is listed below:

- OU3-SO-MRL-18F

XRF screening indicated the sample collected at a one foot depth was in uncontaminated soils.

Soil samples collected one foot below uncontaminated subsurface soils were not collected from eight locations. Water and/or tailings were encountered that could have caved the soil pit in. Revisiting these locations with a geoprobe was planned; however, in concurrence with EPA oversight, the locations were not visited again. Sample locations are listed below:

- OU3-SO-WR-2B
- OU3-SO-MRL-15E
- OU3-SO-MRU-5B
- OU3-SO-MRU-5C
- OU3-SO-MRU-7C
- OU3-SO-MRU-8B
- OU3-SO-MRU-12B
- OU2-SO-45T

Soil samples were not collected at 17 locations due to presence of mud or water. Revisiting these locations to collect a soil sample using a geoprobe or a sediment sample was planned; however, in concurrence with EPA oversight, the locations were not visited again. Sample locations are presented below:

- OU3-SO-FT-2D
- OU3-SO-FT-4D
- OU3-SO-FT-5B
- OU3-SO-FT-5D
- OU3-SO-MRL-14F
- OU3-SO-MRL-15F
- OU3-SO-MRL-17E
- OU3-SO-MRL-17F
- OU3-SO-MRU-9C
- OU3-SO-MRU-11B
- OU3-SO-MRU-13D
- OU2-SO-18F
- OU2-SO-18L
- OU2-SO-18N
- OU2-SO-21L
- OU2-SO-23L

- OU2-SO-49S

In concurrence with EPA oversight, three soil sample locations were not collected due to their location. Sample locations were considered upland and too far away from the floodplain study area. Sample locations are presented below:

- OU3-SO-MRU-7A
- OU3-SO-MRU-9A
- OU3-SO-MRU-10A

Ten soil samples were not collected under or on the north side of Interstate 80 in concurrence with EPA oversight:

- OU2-SO-53N
- OU2-SO-53O
- OU2-SO-53P
- OU2-SO-53R
- OU2-SO-54P
- OU2-SO-54Q
- OU2-SO-55P
- OU2-SO-55Q
- OU2-SO-55R
- OU2-SO-55S

Where possible, surface water flows were measured when surface water samples were collected so that metals loading could be determined for risk evaluation purposes.

In August/ September, flow was not measured at eleven locations due to insufficient water quantity:

- OU3-SW-SCAOU4
- OU3-SW-MRUBP
- OU3-SW-SCURTFB
- OU3-SW-SCRFR
- OU1-SW-PFOU1
- OU3-SW-SC248AC
- OU2-SW-ASCWWT
- OU2-SW-AIRF
- OU2-SW-SCBNPRR
- OU3-SW-SCHFTR
- OU3-SW-SCRF72

In August/ September, no laboratory samples, flow, and field water quality measurements were collected from four piezometers due to insufficient water:

- OU3-SW-SCBOU4
- OU3-SW-SCOU3BC
- OU3-SW-SC248NRB
- OU2-SW-IRF

In October, flow was not measured at three locations due to insufficient water quantity:

- OU1-SW-PFOU1
- OU3-SW-SC248AC
- OU2-SW-ASCWWT

In October, no laboratory samples, flow, and field water quality measurements were collected from three piezometers due to insufficient water:

- OU3-SW-SCOU3BC
- OU2-SW-IRF
- OU2-SW-AIRF: No additional inflow

Based on review of first quarter laboratory data and concurrence with EPA oversight, no water samples, flow data, or field water quality measurements were collected:

- OU3-SW-HS
- OU3-SW-NGCF

3.0 SITE CHARACTERIZATION/DATA EVALUATION

This section provides a characterization of media in OU2 and OU3 by evaluating the data collected during field activities presented in Section 2.0, with the goal of informing the OU2 OU3 removal alternative evaluation. The evaluation considers hydrology throughout OU2 and OU3. Quarterly groundwater elevations and surface water flow measurements collected during field activities are analyzed. Contaminants are characterized for surface water, groundwater, soil, tailings, sediment, and organism tissue. Contaminant concentrations are compared to applicable screening values to determine all exceedances. Details of the site characterization and data evaluation are presented below.

3.1 Hydrology and Hydrogeology

This section characterizes the hydrology and hydrogeology in the area up gradient, down gradient, and throughout OU2 and OU3. The goal is to identify zones of influence and effluence to OU2 and OU3. The characterization evaluates OU2 and OU3 from regional view, using previously published studies and data, then evaluates seasonal changes to surface water flow and groundwater elevations based on data collected during the field investigation discussed in Section 2.0.

3.1.1 Regional Hydrology

Silver Creek is the primary drainage within the watershed. Silver Creek and the adjacent floodplain receive water from sources that include, but may not be limited to precipitation (primarily snowmelt), groundwater, springs, and urban runoff located within its basin. The 1986 Utah Department of Natural Resources (DNR) report "Water Resources of the Park City Area, Utah with Emphasis on Groundwater," prepared in cooperation with the United States Geological Survey (USGS), indicates that Silver Creek obtains its base flow from springs in consolidated rock. The DNR report also indicates that the primary groundwater contributor to Silver Creek base flow is Dorrity Spring, located north of Prospector Square (DNR, 1986).

Long-term meteorological observations have not been kept at the Site. The two nearest meteorological data stations are located in Park City, Utah (which is 500 feet higher in elevation and two miles to the southwest in the Wasatch Mountains), and Kamas, Utah (located at a similar elevation to the Site and nine miles to the east). Annual precipitation for the Site likely falls between the values recorded at the two meteorological stations. Annual precipitation at Park City is 21.44 inches of water with an average annual low temperature of 30.8 degrees Fahrenheit (F) eight and an average annual high temperature of 56.3 degrees F. Annual precipitation at Kamas is 17.27 inches of water per year with an average annual low temperature of 29.0 degrees and an average annual high temperature of 58.7 degrees (www.wrc.dri.edu, 2001). Approximately 90% of annual precipitation in the Park City area is deposited in snowpack. Snowpack melting begins in early March and extends to late May based on elevation. Snowmelt is likely source of groundwater recharge to the Silver Creek watershed.

3.1.2 Groundwater Elevations

Groundwater elevations were collected monthly from March 2015 to February 2016 to determine seasonal fluctuations throughout the Site. Monthly groundwater elevations are presented in Table 2-7. Minimum, maximum, and median groundwater elevations were calculated for each piezometer and presented in Table 3-1. Groundwater elevations fluctuate seasonally. Maximum

groundwater elevations typically occur in winter months and minimum groundwater elevations occur in late summer or fall. Hydrographs are presented in Appendix D for each OU.

OU2 groundwater elevations fluctuate seasonally from 1.5 feet at piezometer P2-5 to over five feet at piezometer T6E0375. This fluctuation is likely due to the piezometers' location. T6E0375 is located in a topographical low at the confluence of two return flow irrigation ditches, see Figure 1-3 Sheet 4. Average groundwater elevation fluctuation in OU2 is three feet.

OU3 groundwater elevations fluctuate seasonally from 0.2 feet at piezometer MR-4 to 5.3 feet at piezometer MR-3. Average groundwater elevation fluctuation in OU3 is just over two feet.

Seasonal fluctuations in groundwater elevations in the shallow unconsolidated aquifer are likely the result of groundwater recharge resulting from snowmelt.

3.1.3 Surface Water

Surface water present in OU2 and OU3 are primarily related to Silver Creek. Silver Creek and the adjacent floodplain receive water from sources including but not limited to precipitation, groundwater, springs, and urban runoff. The primary groundwater contributor to Silver Creek is the Dorrity spring, located north of Prospector Square. Groundwater draining from the Judge Tunnel contributes to Silver Creek via Empire Creek. The headwaters of Silver Creek are located in Ontario, and Empire Canyons.

Flow measurements were collected quarterly between November 2014 and October 2015 from surface water sampling locations. Surface Water flow measurement locations are located along Silver Creek throughout OU2 and OU3. Influent flows entering Silver Creek were measured from the Perennial Flow from OU1, Homer Spring, Inflow from Drainage North of Geneva Concrete Facility, Silver Creek Secondary Channel Inflow, Silver Creek Wastewater Treatment Plant Effluent, Irrigation Return Inflow, and a tributary stream from a neighboring Property near I-80. All locations are presented on Figure 1-2. Flow measurements are presented in Table 2-5. Hydrographs are presented in Appendix D.

Flow rates were collected from a total of twenty seven locations, eight are influent flows into Silver Creek, one is an effluent flow out of Silver Creek, and 18 are located along Silver Creek. Flow rates along Silver Creek ranged from no flow to nearly 11 cubic feet per second depending on the time of year and measurement location. Average flow in Silver Creek was approximately 1.8 cubic feet per second during the study period. Silver Creek typically had low to no flow during the third or fourth quarter, depending on location. Along the entire study reach, flow in Silver Creek increased from no flow upstream of OU4 to over 10 cubic feet per second at Silver Creek and Interstate 80. The Silver Creek Wastewater Treatment Plant provides the greatest

influent flow and to a lesser degree metal loading. Influent flow from the Silver Creek Wastewater Treatment Plant ranged from 1.7 to 2.8 cubic feet per second during the study period. In comparison, all other influent flow rates were below 0.2 cubic feet per second. Consistently high flow rates from the Silver Creek Wastewater Treatment Plant contribute to metals loading in Silver Creek. The Silver Creek Wastewater Treatment Plant contributes a noticeable amount of dissolved lead, as shown in Appendix G. Dissolved lead concentration spikes following the addition of the wastewater treatment plant effluent stream.

Flow rates and mass loading are further analyzed in Section 4.2.

3.2 Characterization of Surface Water, Groundwater, Soil, Tailings, Sediment, and Organism Tissue Contaminant Concentrations

Surface water, groundwater soil, tailings, sediment, and organism tissue contaminant concentrations presented in Section 2.0 were analyzed to determine the nature and extent of contamination, determine overall contaminant fate and transport and if elevated contamination exists that can be targeted for removal alternative evaluation, and to perform an ecological and human health risk assessment. Samples were analyzed for contaminants and applicable parameters discussed in Section 2.0. The following sections present the characterization of each media.

3.2.1 Surface Water Contaminant Concentrations

Surface water samples were collected quarterly for one year from twenty-nine locations. Locations are located along Silver Creek. Silver Creek, influent and effluents to and from Silver Creek and ponded water throughout OU2 and OU3 were sampled. As presented in Table 2-1, quarterly sampling occurred in November 2014, and March, May, August and September, and October 2015. Flow measurements collected during quarterly sampling events are presented in Section 3.1.3 and Table 2-5. Field parameters collected during quarterly sampling events are presented in Table 2-4. Field parameters are typical of surface water with an average pH of 7.3. Surface water cadmium and zinc results are presented on Figure 2-1 and discussed below. Analytical results of all other metals and general chemistry are presented in Table 2-3.

Total cadmium concentrations range from non-detect to 0.022 mg/L. Dissolved cadmium concentrations range from non-detect to 0.00927 mg/L. The maximum total cadmium concentration was collected in November 2014 at Silver Creek below OU4. The maximum dissolved cadmium concentration was collected in March 2015 at the stream located opposite of the Silver Creek Wastewater Treatment Plant effluent. In comparison, the Total Maximum Daily Load (TMDL) for cadmium in Silver Creek is 0.008 mg/L.

Total and dissolved zinc concentrations range from non-detect to 3.15 mg/L. The maximum total and dissolved zinc concentration was collected in March 2015 at the stream located opposite of the Silver Creek Wastewater Treatment Plant effluent. In comparison, the TMDL for zinc in Silver Creek is 0.39 mg/L.

All surface water metals concentrations are further discussed in the mass loading analysis, Section 4.2. Metals concentrations were analyzed during the completion of the Ecological and Human Health Risk Assessments presented in Appendix E and F, respectively.

3.2.2 Groundwater Contaminant Concentrations

Groundwater samples were collected quarterly for one year from November 2014 to October 2015Groundwater samples were collected from twenty-nine piezometers. Six piezometers were installed in the middle reach of OU3. Soil boring logs are presented in Appendix I. Monthly groundwater elevations were collected and previously discussed in Section 3.1.2. Field water quality parameters were collected during each sampling event and are presented in Table 2-8. Groundwater cadmium and zinc results are discussed below. All other analytical results for metals and general chemistry parameters are presented in Table 2-6.

Total cadmium concentrations range from non-detect to 0.436 mg/L. Dissolved cadmium concentrations range from non-detect to 0.426 mg/L. The maximum total and dissolved cadmium concentrations were collected in October 2015 at Piezometer P2-2(B) located in the OU2 floodplain. In comparison, the drinking water maximum contaminant level (MCL) for cadmium is 0.005 mg/L.

Total and dissolved zinc concentrations range from non-detect to 56 and 56.4 mg/L, respectively. The maximum total and dissolved zinc concentrations were collected in October 2014 at piezometer P2-2(B) located in the OU2 floodplain. Due to concentrations of dissolved zinc being greater than total, zinc is likely all in the dissolved form and the difference is within the range of laboratory error. There is not a drinking water maximum contaminant level (MCL) for zinc.

3.2.3 Soil Contaminant Concentrations

Surface and subsurface soil samples were collected from November 2014 to October 2015. Soil sampling locations are presented on Figure 1-4. One-hundred and ninety seven surface and subsurface soil samples were collected from OU2. Three hundred and sixty two surface and subsurface soil samples were collected from OU3. Analytical results are presented in Table 2-9. Arsenic, cadmium, lead, and zinc surface sampling results are presented in Figure 2-2. Arsenic and lead results are discussed below.

Arsenic concentrations range from non-detect to 7,010 mg/kg. The maximum arsenic concentration is located in the OU2 floodplain, location 48T as presented in Figure 1-4 Sheet 4. The maximum concentration was present in the surface sample. Arsenic concentrations decreased in deeper samples collected at this location; 251 mg/kg of arsenic was present between 6 inches and 1 foot, and 8 mg/kg of arsenic was present at a four foot depth. All surface arsenic concentrations are presented in Figure 2-2.

Lead concentrations range from non-detect to 49,600 mg/kg. The maximum lead concentration is located in the OU2 floodplain, location 8G as presented in Figure 1-4 Sheet 3. The maximum concentration was present in the depth sample collected between 6 inches and 1 foot. Lead concentrations were elevated in the surface sample collected at this location, containing 28,900 mg/kg lead. Lead concentrations decreased at deeper depths. The depth sample collected at 2.7 feet beneath ground surface contained 25 mg/kg lead.

All metals concentrations are further discussed in the Streamlined Risk Evaluation, Section 4.2. Metals concentrations were analyzed during the completion of the Ecological and Human Health Risk Assessments presented in Appendix E and F, respectively.

3.2.4 Tailings Contaminant Concentrations

Tailings samples were collected from sixteen locations between November 2014 and September 2015. Sample locations are presented in Figure 1-4. All tailings samples were collected from the Middle Reach of OU3. Analytical results for tailings samples are presented in Table 2-9. Arsenic and lead results are discussed below.

Arsenic concentrations range from 26.4 to 678 mg/kg. The maximum arsenic concentration is located in the OU3 Middle Reach floodplain, location 5B as presented in Figure 1-4 Sheet 1. Tailings were present between 2 and 5 feet below the ground surface at this location. Soil samples were collected above tailings. Twenty-seven mg/kg arsenic was present in the surface sample, 30 mg/kg arsenic was present in the depth sample between 6 inches and 1 foot, and 63 mg/kg arsenic was present in the depth sample collected between 1 and 2 feet beneath the ground surface. Samples were not collected beneath tailings due to unsafe working conditions caused by sample hole depth. The location was meant to be revisited with a geoprobe but this was not completed, as discussed in Section 2.6.

Lead concentrations range from 62.6 to 18,200 mg/kg. The maximum lead concentration is located in the OU2 floodplain, location 5B as presented in Figure 1-4 Sheet 1. Tailings were present between 2 and 5 feet below the ground surface at this location. Soil samples collected above tailings contained elevated concentrations of lead, 744 mg/kg lead was present in the surface sample, 764 mg/kg lead was present in the depth sample between 6 inches and 1 foot,

and 1,590 mg/kg lead was present in the depth sample collected between 1 and 2 feet beneath the ground surface. Samples were not collected beneath tailings due to unsafe working conditions caused by sample hole depth. The location was meant to be revisited with a geoprobe but this was not completed, as discussed in Section 2.6.

3.2.5 Sediment Contaminant Concentrations

Fourteen sediment samples were collected in November 2014 and July 2015. As shown in Table 2-10, sediment samples were analyzed for total metals, total phosphate and percent moisture. Sediment sampling locations are presented in Figure 1-5. Sediment analytical results were compared to bulk sediment toxicity benchmarks for benthic macroinvertebrates as provided by EPA and presented in Table 3 of the approved Quality Assurance Project Plan (QAPP). Metals exceeding benchmarks are discussed below. Total phosphate, percent moisture, barium, beryllium, calcium, cobalt, iron, magnesium, potassium, selenium, sodium, thallium, and vanadium did not exceed benchmarks, or benchmark values were not provided. These parameters are not discussed below.

Aluminum: Concentrations of aluminum range from 1,450 to 36,000 mg/kg. Bulk sediment toxicity benchmarks for benthic macroinvertebrates for aluminum (25,519 mg/kg) were exceeded for one sample located at the Silver Creek SC-1 Culvert (OU3-0-SD-SC1C).

Antimony: Concentrations of antimony range from 24 to 287 mg/kg. All sediment samples exceed the antimony bulk sediment toxicity benchmark for benthic macroinvertebrates (2 mg/kg). The maximum antimony concentration is located at OU3 Silver Creek at the northern boundary of P.C. West Reach (OU3-0-SD-NPCWR).

Arsenic: Concentrations of arsenic range from 27 to 508 mg/kg. All sediment samples exceed the arsenic bulk sediment toxicity benchmark for benthic macroinvertebrates (9.8 mg/kg). Maximum arsenic concentration occurred at the OU2 Silver Creek Wastewater Treatment Effluent location. (OU2-9-SD-SCWWT)

Cadmium: Concentrations of cadmium range from 13.4 to 137 mg/kg. All sediment samples exceed the cadmium bulk sediment toxicity benchmark for benthic macroinvertebrates (1 mg/kg). Maximum cadmium concentration occurred at OU2 Secondary Channel Inflow (OU2-0-SD-SCI).

Chromium: Concentrations of chromium range from 16.2 to 66.5 mg/kg. Three sediment samples exceed the chromium bulk sediment toxicity benchmark for benthic macroinvertebrates (43 mg/kg). Sediment samples exceeding the benchmark are located in OU2 Silver Creek Secondary Channel Inflow (48 mg/kg) (OU2-0-SD-SCI), OU3 Silver Creek SC-1 Culvert

(66.5 mg/kg) (OU3-0-SD-SC1C), and OU3 Middle Reach Upper Beaver Pond (45.5 mg/kg) (OU3-0-SD-MRUBP).

Copper: Concentrations of copper range from 37 to 467 mg/kg. All sediment samples exceed the copper bulk sediment toxicity benchmark for benthic macroinvertebrates (32 mg/kg). Maximum copper concentration is located at OU2 Silver Creek Wastewater Treatment Effluent location (OU2-0-SD-SCWWT)

Lead: Concentrations of lead range from 47.3 to 9,350 mg/kg. All sediment samples exceed the lead bulk sediment toxicity benchmark for benthic macroinvertebrates (36 mg/kg). Maximum lead concentration is located OU2 Silver Creek Wastewater Treatment Effluent location (OU2-0-SD-SCWWT).

Manganese: Concentrations of manganese range from 279 to 6,710 mg/kg. All but two sediment samples exceed the manganese bulk sediment toxicity benchmark for benthic macroinvertebrates (631 mg/kg). All sediment samples collected in OU2 exceed the benchmark concentrations. OU3 sediment samples exceeded benchmarks for all locations except OU3 Middle Reach Upper Beaver Pond (OU3-0-SD-MRUBP) and OU3 Silver Creek at State Route 248 North Reach Northern Boundary (OU3-0-SD-SC248NRB). Maximum manganese concentration is located at OU3 Silver Creek at the northern boundary of P.C. West Reach (OU3-0-SD-NPCWR).

Mercury: Concentrations of mercury range from non-detect to 11.9 mg/kg. All but four sediment samples exceed the mercury bulk sediment toxicity benchmark for benthic macroinvertebrates (0.18 mg/kg). All sediment samples collected in OU2 exceed the benchmark concentrations. OU3 sediment samples exceeded benchmarks for all locations except OU3 Middle Reach Upper Beaver Pond (OU3-0-SD-MRUBP), OU3 Silver Creek SC-1 Culvert (OU3-0-SD-SC1C), and OU3 Silver Creek below Richardson Flat Road (OU3-0-SD-SCRFR). The maximum mercury concentration is located at OU3 Silver Creek at State Route 248 North Reach Northern Boundary (OU3-0-SD-SC248NRB).

Nickel: Concentrations of nickel range from non-detect to 44.1 mg/kg. One sediment sample exceeds the nickel bulk sediment toxicity benchmark for benthic macroinvertebrates (23 mg/kg). The sediment sample collected from OU3 Silver Creek SC-1 Culvert (OU3-0-SD-SC1C) exceeds the benchmark.

Silver: Concentrations of silver range from 9.68 to 47.3 mg/kg. All but one sediment sample exceed the silver bulk sediment toxicity benchmark for benthic macroinvertebrates (1 mg/kg). All sediment samples collected in OU2 exceed the benchmark concentrations. OU3 sediment samples exceeded benchmarks for all locations except OU3 Silver Creek SC-1 Culvert (OU3-0-

SD-SC1C). The maximum concentration of silver is located at OU2 Silver Creek Secondary Channel Inflow (OU3-0-SD-SCI).

Zinc: Concentrations of zinc range from 1,650 to 32,800 mg/kg. All sediment samples exceed the zinc bulk sediment toxicity benchmark for benthic macroinvertebrates (121 mg/kg). The maximum zinc concentration is located at OU3 Silver Creek at the northern boundary of P.C. West Reach (OU3-0-SD-NPCWR).

Sediment concentrations are further described in Section 4.0, and Appendix E and F relating to the Ecological and Human Health Risk assessments.

3.2.6 Organism Tissue Contaminant Concentrations

Organism tissue samples were collected in July 2015. As shown in Table 2-11 to 2-13, organism tissue samples were analyzed for total metals, total phosphate and percent moisture. Organism tissue sampling locations and results are presented in Figure 2-3. Sampling results are summarized below for each media.

Vegetation Contaminant Concentrations

Vegetation samples were collected at 14 locations in OU2 and OU3 as discussed in Section 2.5. Vegetation field data is presented in Table 3-2. Overall, vegetation was described as healthy throughout OU2 and OU3. Twenty eight vegetative species were collected and are presented in Table 3-2. Density, relative density, species coverage, and relative coverage were calculated for each species collected and presented in Table 3-3. Baltic rush (*Juncus balticus*) was the most common vegetative species collected, covering 26% of the sample areas. Reed canary grass (*Phalaris arundinacea)* was the second most common species collected, covering 11% of the sample areas. Analytical results for each metal are summarized below. Antimony, arsenic, beryllium, chromium, copper, nickel, selenium, silver, and vanadium are not described below as all sample results were non-detect.

Aluminum: Concentrations of aluminum range from non-detect to 445 mg/kg. The maximum aluminum concentration is located at OU3 Silver Creek SC-1 Culvert (OU3-0-VG-SC1C).

Barium: Concentrations of barium range from 7.17 to 63.9 mg/kg. The maximum barium concentration is located at OU3 Silver Creek South of Promontory Road (OU3-0-VG-SPCWR).

Cadmium: Concentrations of cadmium range from non-detect to 5.72 mg/kg. The maximum cadmium concentration is located at OU3 Silver Creek Wastewater Treatment Effluent location (OU2-0-VG-SCWWT).

Calcium: Concentrations of calcium range from 3,260 to 33,200 mg/kg. The maximum calcium concentration is located at OU3 Silver Creek South of Promontory Road (OU3-0-VG-SPCWR).

Cobalt: Concentrations of cobalt range from non-detect to 4.56 mg/kg. The maximum cobalt concentration is located at OU3 Silver Creek State Route 248 Alternate Culvert (OU3-0-VG-SC248AC). All other samples contained non-detectable levels of cadmium.

Iron: Concentrations of iron range from non-detect to 512 mg/kg. The maximum iron concentration is located at OU3 Silver Creek Location RF7-2 (OU3-0-VG-SCRF72).

Lead: Concentrations of lead range from non-detect to 71.9 mg/kg. The maximum lead concentration is located at OU3 Silver Creek Location RF7-2 (OU3-0-VG-SCRF72).

Magnesium: Concentrations of magnesium range from 690 to 8,940 mg/kg. The maximum magnesium concentration is located at OU3 Silver Creek North of Promontory Road (OU3-0-VG-NPCWR).

Manganese: Concentrations of manganese range from 15.2 to 622 mg/kg. The maximum manganese concentration is located at OU3 Silver Creek Middle Reach Upper Beaver Pond (OU3-0-VG-MRUBP).

Mercury: Concentrations of mercury range from non-detect to 0.336 mg/kg. Two samples contain detectable levels of mercury and are located at OU3 Silver Creek Location RF7-2 (OU3-0-VG-SCRF72) and OU3 Silver Creek 248 North Reach Northern Boundary (OU3-0-VG-SC248NRB).

Potassium: Concentrations of potassium range from 11,600 to 37,100 mg/kg. The maximum potassium concentration is located at OU3 Silver Creek Location RF7-2 (OU3-0-VG-SCRF72) and OU3 Silver Creek 248 North Reach Northern Boundary (OU3-0-VG-SC248NRB).

Potassium: Concentrations of potassium range from 11,600 to 37,100 mg/kg. The maximum potassium concentration is located at OU3 Silver Creek Location RF7-2 (OU3-0-VG-SCRF72) and OU3 Silver Creek 248 North Reach Northern Boundary (OU3-0-VG-SC248NRB).

Sodium: Concentrations of sodium range from non-detect to 7,000 mg/kg. The maximum sodium concentration is located at OU3 Silver Creek South of Promontory Road (OU3-0-VG-SPCWR).

Thallium: Concentrations of thallium range from non-detect to 36.3 mg/kg. The maximum and only detected concentration of thallium is located at OU3 Silver Creek North of Promontory Road (OU3-0-VG-NPCWR).

Zinc: Concentrations of zinc range from non-detect to 947 mg/kg. The maximum zinc concentration is located at OU3 Silver Creek at the Upper Rail Trail Footbridge (OU3-0-VG-SCURTFB).

Benthic Macroinvertebrate Contaminant Concentrations

Benthic macroinvertebrate samples were collected at 12 locations in OU2 and OU3 as discussed in Section 2.5. Benthic macroinvertebrate analytical results are presented in Table 2-12 and field data is presented in Table 3-4. Twenty-six species of benthic macroinvertebrates were collected. Species sampled, stream conditions, and other species present in sample location are presented in Table 3-4.

Fish Contaminant Concentrations

Fish samples were collected at 24 locations in OU2 and OU3 as discussed in Section 2.5. Fish analytical results are presented in Table 2-13 and field data is presented in Table 3-5. A total of 282 individual fish were collected consisting of four different species. Species sampled, species weight and length, and any visual abnormalities were noted and are presented in Table 3-5. Visual abnormalities were noted in three fish and consisted of red spots on fish tissue. The samples where fish with visual abnormalities are listed below:

- OU2-0-FI-SCBNPRR-SD1
- OU3-0-FI-SPCWR-SD1
- OU3-0-FI-SPCWR-SD2

Analytical results for tissue samples are further discussed in the Ecological Risk Assessment presented in Appendix E.

4.0 STREAMLINED RISK EVALUATION AND MASS LOADING ANALYSIS

A streamlined risk evaluation and mass loading analysis were performed to identify the nature of contamination and evaluate the effects of contamination on the environment and human health. The mass loading analysis evaluates fate and transport throughout Silver Creek and the adjacent floodplain.

4.1 Streamlined Risk Evaluation

The streamlined risk evaluation uses sampling data to identify the Contaminant(s) of Potential Concern (COPCs), provide an estimate of how and to what extent people and the environment might be exposed to the COPC(s), and provide an assessment of effects associated with the CoPC(s). Phase I of the streamlined risk evaluation was completed to identify CoPCs. The

following sections present a summary of the Phase I of the Ecological Risk Streamlined Evaluation (ERE) and Phase I Human Health Streamlined Risk Evaluation (HHRE).

4.1.1 Streamlined Ecological Risk Evaluation

Phase I of an ecological risk evaluation was completed by Alpine EcoSciences to identify CoPCs. The Phase I Streamlined Ecological Risk Evaluation is presented in Appendix E. The objectives of the Phase 1 streamlined ecological risk evaluation were to 1) determine if data are adequate to address ecological risks, 2) identify ecological CoPCs, and 3) determine if the available information and data indicate a potential for adverse ecological effects from exposure to Site-related contaminants at OU2/3.

The table below provides a summary of the chemicals that exceed the screening values, for each medium (and receptor group).

Media	Ecological CoPCs
Surface water	Cadmium, lead, manganese, zinc (aquatic life) Arsenic, barium, cadmium, copper, iron, lead, manganese, zinc (amphibians)
Sediment	Aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, thallium, vanadium, zinc (benthic macroinvertebrates)
Soil	Aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, selenium, silver, thallium, vanadium, zinc (plants/soil invertebrates) Antimony, arsenic, cadmium, chromium, copper, lead, manganese, mercury, selenium, silver, thallium, vanadium, zinc (wildlife)

As noted, the objectives of the Phase 1 streamlined ecological risk evaluation were to 1) determine if data are adequate to address ecological risks, and 2) identify ecological CoPCs, based on a screening of available site data against default screening benchmarks. A scientific/management decision can be made based on the results of this Phase 1 streamlined ecological risk evaluation (the preliminary identification of ecological CoPCs), and that is:

> *The analysis indicates that measured concentrations of chemicals in site media exceed generic ecological risk-based screening values. Therefore, the media and associated exposure pathways cannot be eliminated as posing negligible risk based on this preliminary screening and a more thorough assessment may be warranted.*

Note that U.S. EPA's (1997) guidance states that the scientific/management decision point made at the end of a screening-level risk calculation should not be used to set preliminary cleanup goals:

> *Screening ecotoxicity values are derived to avoid underestimating risk. Requiring a cleanup based solely on those values would not be technically defensible.*

The next step in the streamlined ecological evaluation for OU2/3 could be to perform the exposure estimate and risk calculation, including the development of wildlife exposure models and development of toxicity reference values (TRVs) to assess effects, and the calculation of Hazard Quotients (HQs) to provide quantitative estimates of risk to ecological receptors. As part of this, the preliminary CoPCs could be refined based on site-specific information, and a more detailed characterization of ecological effects could be undertaken. The effects characterization could include reviewing and refining information on contaminant fate and transport; development of a background or reference dataset; and a literature search to identify no-observed-adverse-effect-levels (NOAELs) and low-observed-adverse-effect-levels (LOAELs), exposure-response functions, and the mechanisms of toxic responses that are more tailored to the Site.

A "lines of evidence" approach could be used for making conclusions regarding ecological risk at the Site, which could include species, community, and habitat considerations, comparisons to background or reference data, and an evaluation of the bioaccumulation and tissue residue data that are available for OU2/3.

The results from the any subsequent phase of the streamlined risk evaluation could allow for risk management decisions that include consideration of potential ecological risks from exposure to contaminants at OU2/3, if identified, and development of appropriate remedial options that respond to any ecological risks that may be identified for the Site.

4.1.2 Streamlined Human Health Screening Evaluation

As specified in the EE/CA Field Sampling Plan that was prepared by Resource Environmental Management Consultants (RMC) for United Park, one of the objectives of the effort is to provide an assessment of the potential human health risks associated with the presence of hazardous substances within the Richardson Flat Tailings Site OU2 and OU3. As the initial step in meeting this objective, the results of the extensive data collection effort were screened against risk-based screening levels. The media screened include surface water, ground water, soils, and sediments. The data for these environmental media collected from within OU2 and OU3 were compared to several sets of health-based screening criteria. The screening criteria include the "Preliminary Human Health Screening Levels" that were provided by staff in U.S. EPA Region 8 (Email from

K. Keteles 2015), and some risk-based screening values that were developed for specific sites in the vicinity of OU2 and OU3.

The Preliminary Human Health Screening Levels provided by Region 8 are equivalent to the Regional Screening Levels (RSLs) in the "Generic Tables" provided by U.S. EPA for initial screening of sites. (U.S. EPA 2016). These values are based on standard default exposure assumptions, with no consideration for site-specific factors. As such, they are employed as part of an initial investigation to determine if contamination is present to warrant further investigation (U.S. EPA 2016). The preliminary screening levels utilized in this evaluation include criteria for:

- Residential soils
- Industrial soil,
- Tap water, and
- A risk-based soil screening level developed for the protection of groundwater.

In order to provide information that is more specific to the conditions and uses in the vicinity of OU2 and OU3, additional screenings were performed based on comparison against risk-based criteria developed for two sites upstream of OU2 and OU3; for the Empire Canyon site, United Park worked with risk assessment staff at Exponent, Inc. to develop screening criteria that reflected the anticipated uses of the site. Two sets of risk-based criteria were developed in this context, one associated with recreational uses, and the other for occupational exposures at the site. These screening criteria were used to screen surface soils and sediments at OU2 and OU3. A third set of risk-based screening criteria used in evaluating the data from OU2 and OU3 were drawn from the Baseline Human Health Risk Assessment (BHHRA) performed by U.S. EPA Region 8 for the OU1 of the Richardson Flat Tailings site. In this document, anticipated uses of the area were used to develop exposure scenarios, and those exposure scenarios were, in turn, used to develop site-specific Risk-Based Concentrations for the anticipated recreational uses of the site. Because of the proximity of that site to OU2 and OU3, and because the prior acceptance of these values for application by Region 8, these were also used as a basis of screening the data collected from environmental media in OU2 and OU3.

Consistent with goal of providing a streamlined assessment of site data, the human health assessment included in this document is structured as a set of detailed tables that compare the concentrations of metals measured at the site against the selected screening criteria, described above. Each data point from the site was compared directly, with any exceedances highlighted in the tables. The detailed screening tables are provided in Appendix F, accompanied by a brief memorandum that outlines the technical approaches utilized in the human health screenings.

4.2 Mass Loading Analysis

Mass loading analysis was conducted for total and dissolved arsenic, cadmium, lead and zinc. Appendix G contains the results, tables and figures utilized to determine mass loading in OU2 and OU3. The above metals were selected to represent surface water contaminants of interest from the Silver Creek TMDL (cadmium and zinc) and indicator metals (arsenic and lead) for potential human health exposures. Surface water and flow data were utilized to determine daily mass loading for the first quarter in 2015. There were numerous no flow sections of Silver Creek in the remaining quarterly monitoring periods of 2015 that negated mass loading analyses for the remainder of the year. Mass loading was analyzed from the upstream extent of OU3 to the downstream extent of OU2. Potential sources of loading and dilution was determined.

5.0 CONCLUSIONS AND SUMMARY

There have been numerous investigations and studies conducted and reported on the combined Operable Units which provide an abundance of data. The information, evaluations and activities reported herein expand the data for the Site. Surface water was not present at several monitoring locations due to the lack of surface water in Silver Creek resulting from drought conditions. In general, the information and data presented and summarized in this report are consistent with the data reported by EPA, State of Utah, USGS and United Park in previous studies that have been conducted since 2002. This Report compiles and presents information that has been generated thus far from the Site, including a summary of activities to date, presentation of the data, a characterization of the Site, and streamlined risk assessments as described therein from the perspective of ecological and human health risk.

6.0 REFERENCES

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